REMARKS

The above-identified patent application has been amended and Applicant respectfully requests that the specification, as amended, be examined.

In accordance with 37 CFR §1.121(b), a clean version of the amended specification paragraphs and the claims are provided herein above and a marked up version of the specification paragraphs and the claims indicating the amendment is attached hereto.

Claims 1-18 have been cancelled, claims 19-21 are pending.

The Examiner is respectfully invited to telephone the undersigning attorney regarding this amendment or this application.

The Assistant Commissioner is hereby authorized to charge payment of any additional fees associated with this communication or credit any overpayment to Deposit Account No. 500845.

Respectfully submitted,

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VERSION OF PARAGRAPH WITH MARKINGS TO SHOW CHANGES

Changes to the section labeled Cross-Reference to Related Applications

~~CROSS-REFERENCE TO RELATED APPLICATIONS~~

~~This application is a continuation pending Application No. 09/558,193, filed on April 26, 2000, which claims the benefit of Provisional Application No. 60/177,752 filed on January 24, 2000 and U.S. Provisional Application No. 60/184,006 filed on February 22, 2000, which applications are hereby incorporated by reference in their entireties.~~

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional application of pending application No. 10/139,710, filed May 6, 2002, which is continuation of pending Application No. 09/558,193, filed on April 26, 2000, which claims the benefit of Provisional Application No. 60/177,752 filed on January 24, 2000 and U.S. Provisional Application No. 60/184,006 filed on February 22, 2000, which applications are hereby incorporated by reference in their entireties.

Changes to the paragraph beginning at page 5, line 11

Because of this increase in electrical load, higher power demands are being placed on automotive alternator systems. Furthermore, the increasing power levels have motivated the adoption of a new higher distribution voltage in automobiles to augment and/or replace the current 14 V distribution system. In some cases, a single high-voltage electrical system may likely be used (e.g. a 42 volt electrical system). In other cases, a dual-voltage electrical system may be used which includes a first relatively high-voltage system (e.g. a 42 V electrical system) and a second relatively low-voltage system (e.g. a 14 V electrical system~~.~~). The high-voltage electrical system will be used to power vehicle components which require a relatively large amount of power such as a starter motor of a vehicle. When retained (in the dual-voltage case), the low-voltage system will

be used to power vehicle components that benefit from a low-voltage supply such as incandescent lamps and signal-level electronics.

Changes to the paragraph beginning at page 15, line 15

Fig. 5 is a flow diagram showing the steps to design an alternator in accordance with the present invention;

Changes to the paragraph beginning at page 17, line 6

Referring now to Fig. 1, an alternator system 10 having output terminals 10a, 10b includes a three phase alternator 12 having a field current regulator 14 and a switched-mode rectifier 16 coupled thereto. A field control circuit 14b regulates the output voltage at terminals 10a, 10b of the alternator system. The field control circuit includes a field current regulator 14 and a field controller 14a. The field current regulator 14 receives control signals from a field controller 14a and functions to regulate the output voltage at terminals 10a, 10b of the alternator system 10. The alternator 12 provides power along three signal paths 13a, 13b, 13c to the switched-mode rectifier circuit 16. The switched-mode rectifier receives the power from the alternator 12 and also receives a duty cycle control signal along path 16a from a switched-mode rectifier (SMR) control circuit 18. The SMR control circuit 18 receives sensing signals at an input terminal 18a from a speed sensor 20 which may be provided as a tachometer for example. The speed sensor 20 senses the engine speed or alternator speed and provides a frequency or speed signal to the SMR control circuit 18 along a signal path 18a. It should be appreciated that the speed sensor can sense any parameter or combination of parameters related to ac machine speed (e.g. engine speed, frequency, alternator speed, frequency, alternator back ~~EMF~~ emf or back ~~EMF~~ emf frequency, or any quantity from which the appropriate information can be observed or estimated) and provide an appropriate signal to the SMR control circuit. Based upon the frequency or speed of the alternator 12 the control circuit 18 provides duty signals along signal path 16a to control the operation (e.g. a duty ratio) of the switched-mode rectifier 16.

Changes to the paragraph beginning at page 46, line 25

It should be noted that switching profile of MOSFET~~S~~s 58a' and 58b' must

always provide a flow path for current directed into the center tap of the primary winding 122 of transformer 120. As a result, it must be ensured that switches 58a' and 58b' are never off simultaneously. To guarantee that MOSFETs 58a' and 58b' are never off together, there are intervals during the switching interval where both switches are on. These intervals are utilized for the switches to transition from there on states to their off states, or vice versa. For example, consider the case where MOSFET 58a' is on and MOSFET 58b' is off. Before turning MOSFET 58a' off and MOSFET 58b' on, MOSFET 58b' is turned on. During the interval both MOSFETs are on, the current flowing into the center tap of primary winding 122 of transformer 120 divides equally between section A and section B of primary winding 122. Furthermore, during this interval no current flows in the secondary windings 124 and 126 of transformer 120. The overlap on-time of the MOSFETs is chosen to allow smooth switch state transitions (on to off or off to on) for the switches while accounting for the finite state transition times for practical devices chosen for the particular application. The selected overlap time also provides the mechanism for controlling the average voltage across terminals d and e.

Changes to the paragraph beginning at page 48, line 26

When the MOSFETs 58a-58c are turned on, the current in the machine inductances increases, drawing energy from the low-voltage source and storing it in the machine inductances. When the MOSFETs 58a-58c are turned off, some of this energy plus additional energy from the low-voltage source is transferred to the high-voltage battery 102 through the diodes 56a-56c~~.)~~. The high-voltage battery 102 may be charged from a low-voltage source (for jump-starting purposes, for example) using this method.

In the claims

~~1. An alternator system having an alternating current (ac) voltage source controllable by controlling a field current thereof, said ac voltage source having an output and an internal inductance; the system comprising:~~

~~a rectifier coupled to said ac voltage source;~~

~~a sensor having an input coupled to one of said ac voltage source and an engine and having an output;~~

~~a control circuit coupled to said ac voltage source, said rectifier and said sensor, said control circuit providing a first control signal to said rectifier and providing a second control signal to said ac voltage source; and~~

~~a fault protection controller having an input port coupled to an output of the alternator system and having a first output port coupled to an input of said control circuit.~~

~~2. The alternator system of Claim 1 wherein said control circuit further comprises:~~

~~a multiplexer having a first input coupled to a duty ratio signal, a second input coupled to the first output port of said fault protection controller and an output; and~~

~~a comparator having a first terminal coupled to said multiplexer output, a second terminal coupled to a reference signal, and an output providing the first control signal.~~

~~3. The alternator system of Claim 1 wherein said first control signal comprises a pulse width modulation (PWM) gate command.~~

~~4. The alternator system of Claim 3 wherein the PWM gate command is determined by said fault protection controller.~~

~~5. The alternator system of Claim 3 further comprising:~~

~~a field control circuit coupled to said alternating current (ac) voltage source; and~~

~~wherein the second control signal comprises a field controller command to the~~

~~field control circuit and wherein the gate command and the field controller command are determined based on the alternator system output voltage and the sensor output.~~

~~6. The alternator system of Claim 5 wherein said fault protection controller further comprises a second output port coupled to said field control circuit.~~

~~7. The alternator system of Claim 5 wherein said control circuit comprises a compensator for receiving a desired output voltage and an actual output voltage and for generating a control signal based on a desired output voltage and the actual output voltage.~~

~~8. The alternator system of Claim 7 wherein said control circuit further comprises:~~

~~a limiter having an input coupled to the output of said compensator and having an output coupled to an input of said field control circuit;~~

~~a controlled limiter for receiving a first input signal from said sensor and a second input signal from said compensator and for providing a controlled limiter control signal at an output thereof; and~~

~~a comparator adapted to receive a reference signal at a first input terminal, the controlled limiter control signal at a second input terminal and for providing a comparator output signal at an output terminal coupled to said switched-mode rectifier.~~

~~9. The alternator system of Claim 1 wherein said rectifier includes a transformer.~~

~~10. The alternator system of Claim 1 wherein said rectifier includes a diode bridge.~~

~~11. The alternator system of Claim 10 wherein said rectifier further includes a boost switch set coupled to said diode bridge.~~

~~12. The alternator system of Claim 11 wherein said boost switch set comprises:~~

~~a controlled switch coupled to said control circuit; and~~

~~a diode coupled to said controlled switch.~~

~~13. The alternator system of Claim 1 wherein said rectifier comprises a switched mode rectifier.~~

~~14. The alternator system of Claim 1 wherein said speed sensor senses at least one of:~~

~~(a) an ac voltage source speed;~~

~~(b) an ac voltage source frequency; and~~

~~(c) an ac voltage source back emf.~~

~~15. An alternator system for providing an output voltage level at an output port thereof, the alternator system comprising:~~

~~an alternating current (ac) voltage source controllable by controlling a field current thereof, said ac voltage source having an output and an internal inductance;~~

~~a rectifier coupled to said ac voltage source;~~

~~a sensor having an input coupled to one of said ac voltage source and an engine and having an output;~~

~~a control circuit coupled to said ac voltage source, said rectifier and said sensor, said control circuit for sensing an output voltage level at the output port of said alternator system and for comparing the sensed output voltage to a reference value and for providing control signals in response to the comparison;~~

~~a field controller coupled to said alternating current (ac) voltage source to control the field current of said ac voltage source;~~

~~a limiter having an input coupled to the output of said compensator and having an output coupled to an input of said field control circuit; and~~

~~a controlled limiter for receiving a first input signal from said sensor and a second input signal from said compensator and for providing a controlled limiter control signal at an output thereof.~~

~~16. The system of Claim 15 further comprising a fault protection controller having an input port coupled to an output of the alternator system and having a first output port coupled to an input of said control circuit.~~

~~17. The system of Claim 15 wherein said rectifier comprises a switched mode rectifier.~~

~~18. The system of Claim 15 wherein said speed sensor senses at least one of:~~

~~(a) an ac voltage source speed;~~

~~(b) an ac voltage source frequency; and~~

~~(c) an ac voltage source back emf.~~

19. A system for charging a battery coupled to an output of a switching power converter from a charging source having a positive terminal and a negative terminal, the system comprising:

an ac machine coupled to an input of the switching power converter; and

a connecting means for selectively connecting the positive terminal of the charging source to said ac machine.

20. The system of Claim 19 wherein the negative terminals of the charging source and the battery are connected to system ground.

21. The system of Claim 19 wherein said charging source has a voltage level which is less than the voltage level of the battery.